29 April 1964

[redacted]

Dear [redacted] STATINTL

We are enclosing a copy of [redacted]s paper on STATINTL
the BIMAT process and a reference to a report made by our [redacted] STATINTL
on a government contract which also provides information on the process.
On my last trip to your building, [redacted] also expressed interest in STATINTL
the process, specifically with regard to [redacted]s lecture. Will STATINTL
you please show the material to him.

STATINTL We hope this material will serve your needs.

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[redacted]

STATINTL RDP:ldm
Enc.

cc: [redacted] - w/o enc. STATINTL
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# A NEW [redacted] PROCESSING METHOD FOR THE AEROSPACE AGE

By

STATINTL [redacted]

Dept of Commerce
Off of Tech. Ser.
Rept. AL-TDR-64-6

STATINTL The new [redacted] processing method makes use of a processing film (formerly called a "web") to develop the exposed film to a negative and produce a positive in a single operation. The process is non-

STATINTL liquid in the sense that, when the processing film is ready for use, it is merely damp to the touch and liquid cannot be squeezed or shaken from it. The fundamentals of the process were presented by [redacted] of the [redacted] during the STATINTL meeting, in May, 1962, at Boston, Massachusetts, of the Society of Photographic Scientists and Engineers. His paper, "A Diffusion-Transfer Web Process," which described a diffusion-transfer method for producing negative images with [redacted] Special High Definition STATINTL Aerial Film, Type SO-243, will be published later.

STATINTL Although the process produced negatives of excellent quality with the SO-243 film, no attempt was made to produce a useful posi-

STATINTL tive image in the web. Subsequently, intensive investigations by [redacted] and colleagues have resulted in a process which provides a positive image and which can be used to process other [redacted] aerial films.

The steps in the process are shown diagrammatically in Fig. 1.

STATINTL The processing film, [redacted] Bimat Film (ESTAR Base), SO-111, is soaked in a developer containing a silver halide solvent. The film is then placed in intimate contact with the exposed, light-sensitive material and the solution immediately begins to diffuse into the negative emulsion layer. If an appreciable amount of time elapses between the removal of the processing film from the developer and the lamination with the negative material, precautions should be taken to protect the saturated film from evaporation or atmospheric oxidation. Exposed negative grains begin to develop, and the unexposed grains start to dissolve in the silver halide solvent. As the process continues, some of the dissolved silver halide diffuses to the processing film where it is reduced to silver on the nuclei present and forms a positive image.

STATINTL There are three systems employing this processing technique that are currently being investigated in the [redacted] STATINTL

1. A simple wind-up process.
2. A continuous process using two processing films.
3. A continuous process using a single processing film.

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Presented at the 1963 Annual Conference of The Society of Photographic Instrumentation Engineers. This paper is prepublished with the permission of the SPIE.

In all three, the processing film can be soaked with processing solution just before contact with the exposed sensitized film, or it can be presoaked and stored ready for use. The latter method is more attractive for most applications envisaged and is now receiving the major emphasis. The keeping stability of the presoaked material is still under investigation, but indications are that it is satisfactory for a period of one to two weeks at room temperature and probably for a month or more at refrigerator temperature.

Wind-Up Process (Fig. 2)

The presoaked processing film, SO-111, is laminated to the exposed, light-sensitive film by winding the two together on a single spool. The two are kept in contact for the proper length of time, which depends on the type of film. Since the process is self-limiting, the films can remain in contact for a considerable time before they are unwound and separated, provided they are not allowed to dry while in contact. [redacted] Special PLUS-X Aerial Film (ESTAR Base), Type SO-135, and [redacted] Special PANATOMIC-X Aerial Film (ESTAR Base), Type SO-136, can be processed with processing film that has been soaked in special processing solution, MX-482. Processing is complete for PLUS-X in 20 minutes and in 15 minutes for PANATOMIC-X, both at 80° F.

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The outstanding advantage of this mode of operation is that it accommodates varying rates of film transport through the camera, including intermittent. It is especially suitable, for instance, for tactical reconnaissance, since viewing during flight is not required and a positive image and a processed negative are available as soon as the aircraft returns. Representative sensitometric data for the SO-135 used in this manner are shown in Fig. 3.

Two-Step Process (Fig. 4)

In this process, two [redacted] Bimat Films are used. Both are presoaked in processing solution, MX-527. The first strand of processing film is laminated to the exposed film and the processing film is separated as soon as the positive image is formed -- in one minute at 90° F, with present technology. The light-sensitive material (negative) is then immediately relaminated to a second strand of processing film. The second processing film and the negative material are kept in contact for a minimum time of 4 to 5 minutes. The two can then be separated or allowed to remain in contact until it is convenient to separate them. The negative is then dried, or washed and dried. The second positive image may or may not be useful. The evident advantage of this mode is the quick access to the positive image that it provides. It completes the processing of the sensitized film, [redacted] Special Aerial Film (ESTAR Base), Type SO-140, to a normal high-quality negative.

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Figure 5 shows representative sensitometric properties of the negative and positive produced. The aerial exposure index of the negative is about 8.

Continuous Process Using a Single Processing Film (Fig. 6)

In this process, presoaked processing film is laminated to the exposed negative in a continuous processor and the two are allowed to remain in contact until processing is complete. They are then separated and are dried, or otherwise protected, before being wound up. At the present time, there are no products commercially available that make this method practical. With the materials described by [redacted] it was necessary for the negative to remain in contact with the processing film for a minimum of 4 minutes, at room temperature, for completion of the reactions. Consequently, the transport rate was relatively slow so that the equipment could be kept to a reasonable size. With a processing time of 15 minutes, the transport rate must be even more drastically reduced. However, this method is mentioned because there are cases where the transport rate can be low. It is probable that the processing rate can be increased in the future and that this method will become more feasible. STATINTL

Summary of Advantages

Among the important advantages of processing with [redacted] Bimat Film (ESTAR Base), SO-111, in aerospace applications are: STATINTL

1. The soaked web offers no solution-containment problem.
2. A positive image is produced for immediate use.
3. A high-quality negative is produced.
4. The materials are simple and convenient to handle.
5. Separate fixing is not required.
6. Automatic, unattended processing is possible.
7. Fresh processing solution is used on all film areas, which insures consistent and reproducible results.
8. No crystalline deposit is left on the films after separation.
9. Processing is not affected by position or orientation of the equipment.
10. The positive and the negative can be washed to provide archival permanence.

Speed and Definition with Processing-Film Systems

At present, the higher-speed films tend to be somewhat slower, gamma is usually somewhat lower, and fog is often higher, when they are processed with Bimat Film. This difference, as seen in Fig. 3, does not appear to be very significant. On the other hand, image definition tends to be somewhat better with processing-film development. Figure 7 shows modulation transfer function curves for [redacted] Special PLUS-X Aerial Film (ESTAR Base), Type SO-135, processed by the conventional method and by this new method. Resolving-power data are shown in Table I. STATINTL

Table I

STATINTL RESOLVING POWER [redacted] Special PLUS-X Aerial Film (ESTAR Base) SO-135

| | 1000:1 | 1.6:1 |
|---|---|---|
| Negative processed by SO-111 | 102 | 45 |
| STATINTL Negative processed by [redacted] D-19 Dev. | 112 | 43 |
| Positive image on SO-111 film | 70 | 28 |

Equipment

Emphasis has been placed on the advantages of this new process, and a brief description of the materials available has been given. The process cannot be operated, of course, without special equipment. Therefore, it must be emphasized that the equipment -- its design, engineering, and construction -- is as important to the successful attainment of the advantages listed as are any of the other components. STATINTL [redacted] has been considering these problems and has been actively engaged in work on equipment for the process.

However, for preliminary laboratory investigations, rather simple equipment can be used. For simple tests, the processing film can be soaked in a container such as a cylinder or a tray, and, after squeegeeing, hand-laminated with a roller to the film supported on a smooth surface.

A rewind presoaker is shown in Fig. 8 and a motorized soaker in Fig. 9. A simple laminating device is shown in Fig. 10. Its essential features are two supply spindles, a wind-up spindle, and a laminating pressure pad. Convenient features are a lighttight arrangement for the sensitized-film supply spindle and for the wind-up spindle.

For the two-step system, an arrangement similar to that shown in Fig. 4 can be used. Lighttight boxes to hold the sensitized material before it is processed are also a convenient feature. Handling equipment for use after processing is complete can be merely that required for manual washing and drying, or more sophisticated continuous washing and drying equipment can be employed.

Summary

Sufficient experimental experience has been gained with Bimat Film processing to indicate its adaptability to a wide variety of processing situations. In addition to the military reconnaissance applications of the process, the simplicity, convenience, short access time, and solution-containment features should be of considerable interest in many applications of photography in which it is important to process without the need for free solutions, replenishment, chemical control, or highly technically trained operators. The STATINTL [redacted] STATINTL is prepared to provide technical assistance in the applications of this processing method and to assist in development of specific processing systems. Inquiries should be addressed to the [redacted]

STATINTL [redacted]

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## Instructions for the Preparation and Use of [redacted] Bimat Film (Estar Base) Type SO-111

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Treat the [redacted] Bimat Film (Estar Base) Type SO-111 in [redacted] Bimat Imbibant MX-482-1 for five minutes at 80° F. Keep the dry roll of film above the surface of the solution, introducing the film into the solution as it is unwound. From this point, the film can be soaked in a continuous mode, avoiding roller contact with the processing surface as far as possible, or in a batchwise method such as by rewinding in a regular aerial film rewind processing tank. It is very important that cleanliness be observed in the presoaking operation if spot-free results are to be produced in processing. The [redacted] Bimat Imbibant MX-482-1 should be free of suspended matter, and the film should be handled carefully to avoid rubbing the edges, with the consequent danger of skiving material from the edges. STATINTL

At the end of the soaking period, the film should be wound smoothly onto a core, using moderate tension. The presoaked roll should be blotted free of excess liquid, sealed in a vapor-tight package, and allowed to stand for at least 30 minutes at about 70° F. to reach equilibrium before it is used.

Bring the presoaked film and the exposed negative together under moderate tension, laminating them smoothly as they are wound on a core. It is important that the [redacted] Bimat Film (Estar Base) Type SO-111 not be permitted to partially dry as it is unwound and laminated to the negative. Allow the [redacted] Bimat Film (Estar Base) Type SO-111 and negative to remain in contact for at least 20 minutes at 80° F. STATINTL STATINTL

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Separate the [redacted] Bimat Film (Estar Base) Type SO-111, which is now a film positive, from the negative. For short-term use both the positive and the negative can be dried without further treatment, and they will remain free of tackiness in a dry atmosphere. For long-term storage, the positive and the negative should be washed in water, and dried using conventional techniques.

### Mixing Instructions for [redacted] Bimat Imbibant MX-482-1 STATINTL

1. Pour contents of Part A into 1 quart measuring vessel. Flush bottle twice with 75-100ml of water and add rinse to Part A.

2. Add contents of Part B to mixing vessel. (Avoid contact with powder.) Flush container twice with water, adding rinses to mix.

3. Adjust volume to 1 quart with 70° F. water.

4. Stir for about 10 minutes. Avoid air entrainment.

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[redacted]

# PROCESSING WITHOUT FREE LIQUIDS!

# A PRINT IS MADE WHILE NEGATIVE DEVELOPS!

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Here is a negative on [redacted] Special PLUS-X Aerial Film (ESTAR Base), Type SO-135, which was processed by contact with [redacted] BIMAT Film (ESTAR Base), Type SO-111. The BIMAT Film was presoaked in [redacted] BIMAT Imbibant, MX-572. The two films may be dried directly, but these were washed for permanence.

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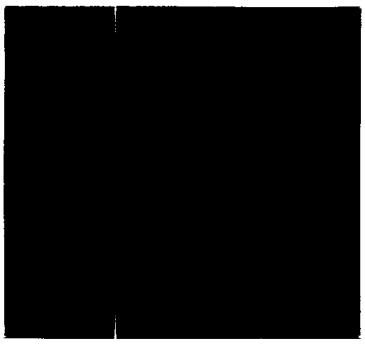

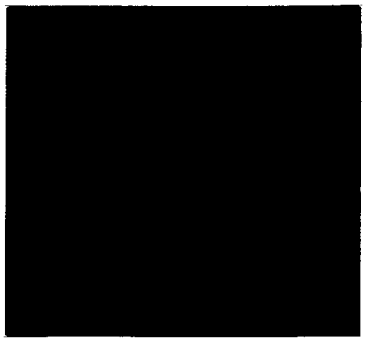

NEGATIVE FILM

[redacted] *BIMAT* FILM

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[redacted]

3-64 Minor Revision
70-L-GLP-B